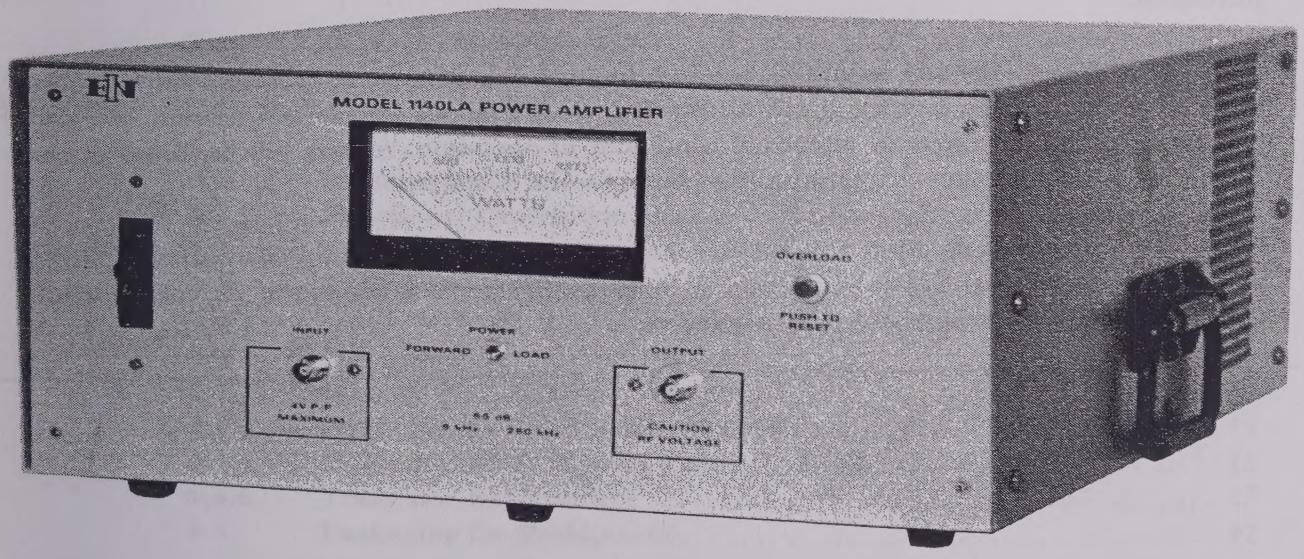
ELECTRONIC NAVIGATION INDUSTRIES, INC.

INSTRUCTION MANUAL

MODEL 1140LA

POWER AMPLIFIER



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WARRANTY

Electronic Navigation Industries, Inc. warrants each instrument to be free from defects in material and workmanship. Our liability under this warranty is limited to servicing and replacing any defective parts for a period of one (1) year after delivery to the original purchaser.

When warranty service is required, the instrument must be returned transportation charges prepaid to the factory or our authorized service facility. If, in our opinion, the fault has been caused by misuse or abnormal conditions of operation, repairs will be billed at cost. In this case, an estimate will be submitted before work is started.

There are no other warranties expressed or implied, including any warranty of merchantibility or fitness. Seller shall not be responsible for any incidental or consequential damages arising from any breach of warranty.

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CHAPTER 1 GENERAL INFORMATION

1.1 INTRODUCTION

The ENI Model 1140LA is an all solid state power amplifier that operates over the frequency range of 9 kHz to 250 kHz with a gain of 55dB. Its 50 ohm input is compatible with any laboratory signal generator, function generator or integrated circuit oscillator. Output power from zero to more than 1500 watts is continuously adjustable by varying the amplitude of the low level input. Any load impedance (from an open to a short circuit) may be connected to the output of the 1140LA without fear of damage or oscillation. The unit provides maximum power transfer to a 50 ohm load impedance, however any load impedance between 40 to 60 ohms can be driven with no reduction in power output.

A built-in true average power meter measures both the power leaving the 1140LA (forward power) and the power absorbed by the load (load power). Extraordinary meter accuracy is provided by a unique computer circuit in the output. By adjusting the tuning (or frequency of the load) and observing the increase in load power, optimum match can be readily achieved.

Complete with built-in power supply and cooling system, the 1140LA will operate from any 115 Vac line with a 35 ampere capacity.

1.2 DATA SUMMARY

Frequency Coverage:	9 kHz to 250 kHz	Thermal Protection:	Thermostatic protection provides automatic cut-out should the power transistors overheat due to load mismatch or cooling system failure. Automatic reset upon cooling.
Gain:	55dB (nominal)		
Gain Variation:	±1dB from 9 kHz to 250 kHz (measured at 1000 Watts)		
Drive Source Requirement:	Any signal generator, function generator or oscillator capable of up to 3.0 volts P-P output into 50 ohms.	Power Meter:	True average reading accurate to better than ±3 percent of full scale (0-2000 watts). Front panel switch permits measurement of the forward power (power leaving the amplifier) and the actual power absorbed by the load.
Maximum Power Output:	Greater than 1.5 kilowatts, 9 kHz to 50 kHz Greater than 1.1 kilowatts, 50 kHz to 250 kHz		

Input Impedance:	50 ohms
Matched Output Load Impedance:	50 ohms; the unit will supply full power to any load impedance between 40 and 60 ohms, resistive.
Power Required:	115 Vac, 50-60 Hz, 35 amperes maximum
Mismatch Protection:	The unit will tolerate up to 400 watts of power reflected from any load impedance, subject to operation of the thermal protection. Instantaneous cutout is provided should the mismatch exceed allowable limits.
Operating Temperature:	0° to 45° Ambient
Size:	8¾ x 17 x 20¼ in. 22 x 43.2 x 51.4 cm.
Weight:	50 lbs., 22.7 kgs.
Connectors:	BNC
Rack Mounting:	19 inch rack adaptors are provided.

CHAPTER 1 GENERAL INFORMATION

1.1 INTRODUCTION

The ENI Model 1140LA is an all solid state power amplifier that operates over the frequency range of 9 kHz to 250 kHz with a gain of 55dB. Its 50 ohm input is compatible with any laboratory signal generator, function generator or integrated circuit oscillator. Output power from zero to more than 1500 watts is continuously adjustable by varying the amplitude of the low level input. Any load impedance (from an open to a short circuit) may be connected to the output of the 1140LA without fear of damage or oscillation. The unit provides maximum power transfer to a 50 ohm load impedance, however any load impedance between 40 to 60 ohms can be driven with no reduction in power output.

A built-in true average power meter measures both the power leaving the 1140LA (forward power) and the power absorbed by the load (load power). Extraordinary meter accuracy is provided by a unique computer circuit in the output. By adjusting the tuning (or frequency of the load) and observing the increase in load power, optimum match can be readily achieved.

Complete with built-in power supply and cooling system, the 1140LA will operate from any 115 Vac line with a 35 ampere capacity.

1.2 DATA SUMMARY

Frequency Coverage:	9 kHz to 250 kHz	Thermal Protection:	Thermostatic protection provides automatic cut-out should the power transistors overheat due to load mismatch or cooling system failure. Automatic reset upon cooling.
Gain:	55dB (nominal)		
Gain Variation:	±1dB from 9 kHz to 250 kHz (measured at 1000 Watts)		
Drive Source Requirement:	Any signal generator, function generator or oscillator capable of up to 3.0 volts P-P output into 50 ohms.	Power Meter:	True average reading accurate to better than ±3 percent of full scale (0-2000 watts). Front panel switch permits measurement of the forward power (power leaving the amplifier) and the actual power absorbed by the load.
Maximum Power Output:	Greater than 1.5 kilowatts, 9 kHz to 50 kHz Greater than 1.1 kilowatts, 50 kHz to 250 kHz		

Input Impedance:	50 ohms
Matched Output Load Impedance:	50 ohms; the unit will supply full power to any load impedance between 40 and 60 ohms, resistive.
Power Required:	115 Vac, 50-60 Hz, 35 amperes maximum
Mismatch Protection:	The unit will tolerate up to 400 watts of power reflected from any load impedance, subject to operation of the thermal protection. Instantaneous cutout is provided should the mismatch exceed allowable limits.
Operating Temperature:	0° to 45° Ambient
Size:	8¾ x 17 x 20¼ in. 22 x 43.2 x 51.4 cm.
Weight:	50 lbs., 22.7 kgs.
Connectors:	BNC
Rack Mounting:	19 inch rack adaptors are provided.

CHAPTER 2 OPERATION

2.1 INTRODUCTION

The ENI 1140LA is used to increase the power output of signal sources in the 9 kHz to 250 kHz frequency range. No tuning or any other form of adjustment is required.

The unit will produce power into any load impedance, but in order to achieve maximum power the load should be matched as closely as possible to 50 ohms.

2.2 RACK INSTALLATION

Rack mounting brackets are supplied with the 1140LA for installation in any standard nineteen inch relay rack cabinet. To attach the brackets to the 1140LA, remove the three #8-32 screws on each side of the cover nearest the front panel. Verify the left and right rack mounting brackets by holding them next to the screw holes. Mounting bracket overhang should be at the bottom of the unit. Attach the mounting brackets to the sides of the unit by inserting the screws previously removed through the corresponding holes in the brackets. Tighten securely. The bottom feet may be unscrewed and removed if the minimum vertical usage of the relay rack is necessary.

2.2.1 Mains Lead Connection

The Model 1140LA requires a 115 volt, 50-60 Hz, single phase power source with a minimum fused capacity of 35 amperes. A standard three pin grounded plug (NEMA- L5-30P) is provided for attachment to a receptacle (NEMA-L5-30R) or this plug may be removed and hard wired to the power mains as follows:

BLACK - Live
WHITE - Neutral
GREEN - Earth

2.3 OPERATING INSTRUCTIONS

To operate the Model 1140LA, the circuit breaker on the left side of the front panel should be flipped to the ON position.

Connect the output of an appropriate signal source, (signal generator, function generator or oscillator) to the INPUT connector on the Model 1140LA. The input level should initially be kept below 1 volt peak-to-peak.

Connect a 50 ohm coaxial cable between the OUTPUT connector of the Model 1140LA and the load. Place the POWER switch, located below the output meter, in the FORWARD position. The output power meter will indicate the power being delivered to the load. In the LOAD position

the output power meter indicates the power being absorbed by the load. The difference between these two readings is the reflected power which is absorbed in the amplifier. If the reflected power exceeds 400 watts, the Model 1140LA will automatically cut-out and the OVERLOAD lamp will light. In order to reset the 1140LA, the input signal should be reduced and the OVERLOAD button which is part of the Overload lamp should be depressed.

Under certain load mismatches or cooling system failure, the Model 1140LA will cut-out due to overheating. When this occurs the OVERLOAD lamp will light. This condition cannot be reset from the front panel but will automatically reset upon cooling of the amplifier heatsinks. Reset should occur within 2 minutes.

If the output is allowed to exceed 1600 watts the circuit breaker may reset to the OFF (red flag) position and shut down the unit.

Now that the front panel controls and indicators are understood, the input signal voltage can be increased until the required power output is delivered to the load. Do not under any circumstances increase the input level beyond 4 volts peak-to-peak or permit the signal source frequency to extend below 6 kHz. Severe damage may result from these actions.

2.4 PERFORMANCE CHECK

The electrical performance of the Model 1140LA should be verified as soon as possible after receipt. This procedure will verify that the Model 1140LA will deliver more than 1500 watts of power from 9 kHz to 50 kHz and more than 1100 watts from 50 kHz to 250 kHz:

(1) Connect an appropriate signal generator to the input of the Model 1140LA.

(2) Connect the Model 1140LA output to a 30dB, 2000 watt attenuator (Bird 8329 or equivalent). If a calorimetric wattmeter (HP434A or equivalent) is available, connect the output of the attenuator to its input.

(3) Set the signal source to CW, output level to approximately 1.5 volts peak-to-peak and frequency to 250 kHz. Increase the input signal until 1100 watts is indicated on the 1140LA output power meter.

(4) Slowly decrease the frequency while observing the power meter. Note that at every frequency down to 9 kHz, the power output is in excess of the specifications. The power indicated on the 1140LA meter should be within ± 3 percent of that indicated on the calorimeter.

.5 TUNING THE LOAD

o operate the Model 1140LA at its maximum efficiency the load impedance should be as close to 50 ms resistive as possible. Tuning the load to 50 ohms is a simple matter using the 1140LA power. eter. The following procedure is useful in tuning a piezoelectric or magnetostrictive transducer:

(1) Place the transducer into an actual mechanical operating environment.

(2) Set the input level of the 1140LA so that the forward power is 350 watts or less.

(3) Observe the load power, while tuning the operating frequency for resonance. At resonance the load power will be maximum.

(4) Using a variable reactive tuning network or element (capacitance for magnetostrictive and inductive for piezoelectric) tune for maximum load power. At maximum load power all of the reactance has been tuned out and the load is pure resistive.

(5) If there is still a substantial difference between the forward and the load power, a tapped transformer, (step-up or step-down depending on the load resistance) should be connected between the 1140LA and the transducer. Change the transformer taps in the direction of increasing load power. When the load power equals the forward power, the impedance is 50 ohms resistive.

Further information on transducer matching as well as available transformers and bias pplies may be obtained by contacting the ENI engineering department.

CHAPTER 3 TECHNICAL DESCRIPTION

3.1 GENERAL DESCRIPTION

The Model 1140LA is designed to amplify signals by 55dB in the frequency range of 9 to 250 kHz. The signal from the front panel connector is fed via a length of 50 ohm coaxial cable to K5 pin 4 located on the front panel assembly (1140LA-3331). (See figure 5-1). Relay K5, pins 4 and 7 are normally closed when K5 is energized, thus allowing the input signal to pass through to the power supply and driver module (1140LA-4332). The input signal is coupled to T1 (which provides isolation for the 135 VDC power supply) and C1 to the base of low noise transistor Q4. The amplified signal at the collector of Q4 is matched, split and phase reversed by transformer T2. Two equal amplitude, phase reversed signals are fed to the bases of Q5 and Q6. The power outputs of Q5 and Q6 are combined and matched in phase reversing transformer T3. The output at T3 is matched phase reversed and split into four equal amplitude signals by T4, T5 and T6. These signals are then fed to the inputs of the four power amplifier modules.

At each of four power amplifier modules (RS-8-4781) hybrid transformers T1, T2 and T3 split the signal into four equal phase and amplitude signals. These signals are fed to the bases of eight final power amplifier transistors (Q1 - Q8). These transistors are so arranged as to form four parallel sets of two. The outputs at the collectors of each pair are fed through their associated fuses to combining hybrids T4, T5 and T6. Fuses (F1-F4) protect the DC power supply should a transistor failure occur.

The outputs from the four power amplifier modules are fed to the output combiner module (RS-16-4801) where transformers T1, T2 and T3 combine and match the signals to form a single 50 ohm output.

The meter control circuit (part of 1140LA-4332) which is connected to the output of the 1140LA measures both the forward and the load power. A front panel switch (S3) selects either the forward or actual load power on the meter display. This is accomplished passively by a five transformer matrix (T7-T11) which uses a broadband ferrite loaded transmission line coupling mechanism. The output of this matrix is divided into two channels for final computation in an integrated circuit multiplier. The output of the multiplier drives the meter display. The 1140LA is designed to withstand 400 watts of reflected power. Should the reflected power exceed 400 watts, a +1 VDC potential is developed across R33. This +1 VDC is sent to the overload relay module (EGB 1400-4504). This energizes the overload relay which in turn energizes K2 and K4. With K2 energized the 135 VDC is removed from the power supply and driver module and the power amplifier modules. With K4 energized DS1 illuminates and K5 is de-energized thereby breaking the input signal path and placing the unit into an overload condition. Reducing the input drive level and depressing the overload reset button (S1) will make the unit operational once again. In an overheat condition, normally open thermal switch (TS1) will close, which in turn energizes K2 and K4. Depressing the overload button (S1) will have no effect in the overheat mode. After approximately 2 minutes the unit will automatically reset itself..

The amplifier power requirements are 115V ac at 35 amperes. Regulated DC is supplied by the series pass transistors Q9 - Q18 (RS-16-4803) driven by Q8 in a Darlington arrangement. Voltage control and feedback are provided by Q1, Q7 (1140LA-4332) and their associated components. The power supply voltage is adjusted to +135 VDC by R20. The regulated +135 VDC output of the power supply is also fed to Q2 and Q3 which in turn provide the lower working voltage for the driver amplifier.

CHAPTER 4 MAINTENANCE

4.1 INTRODUCTION

The ENI 1140LA power amplifier requires no periodic maintenance. The instrument is unconditionally stable and is failsafe under all load conditions. Damage can only be externally caused by an input signal in excess of the specified 4 volt peak-to-peak maximum or operation below 6 kHz.

This chapter therefore deals only with certain fundamental procedures for fault location and with subsequent re-alignment procedures.

Performance limits quoted are for guidance only and should not be taken for guaranteed performance specifications unless they are also quoted in the data summary section 1.2.

4.2 FUNCTIONAL DESCRIPTION

The Model 1140LA RF Power Amplifier is constructed on a modular basis, so that practically every module is readily accessible from the front, sides and top of the unit. To further facilitate servicing the entire amplifier is constructed on a removable "U" shaped chassis. The 1140LA consists of five distinct assemblies, the description of which and their location follows:

(a) Power Amplifier, RS-8-4781

The four power amplifier modules are located on the left and right sides of the amplifier "U" chassis. The power amplifiers are connected to the external circuitry by multi-pin connectors located at the top of each module. To remove the modules it is necessary to disconnect these connectors and remove the eight hold down screws on each module.

(b) Power Supply and Driver, 1140LA-4332

The power supply and driver module is located across the center of the "U" assembly. Its function is to provide pre-amplification to the power amplifiers and to provide a regulated source of DC voltage for the power supply regulator.

(c) Power Supply Regulator, RS-16-4803

The power supply regulator module is located across the center of the "U" assembly next to the power supply and driver module. Its function is to supply regulated DC voltage to the power amplifier modules.

(d) Meter Control, 1140LA-4332

The meter control circuitry is located on the power supply and driver module which is located across the center of the "U" assembly. Its function is to monitor the output power of the unit and to provide control signals to the overload relay located on the front panel assembly.

(e) Output Combiner, RS-16-4801

The output combiner module is located across the center of the "U" assembly below the power supply and driver module and the power supply regulator. Its function is to take the outputs of each of the four power amplifiers, combine them and provide a single 50 ohm output to the meter control module.

4.3 TROUBLESHOOTING

The first step in isolating a malfunction is to review the conditions under which the symptoms were observed and check that it was not caused by external cabling, transducer failure or external electrical problems.

Commonly found symptoms together with their probable causes and troubleshooting recommendations are listed in the troubleshooting guide, Table 4-1.

TABLE 4-1. TROUBLESHOOTING GUIDE

SYMPTOM	PROBABLE CAUSE	RECOMMENDATIONS
Fan does not run with circuit breaker in the ON position.	Main line fuse or circuit breaker is sufficient to handle the current draw.	Make sure line fuse or circuit breaker is capable of 35 amperes capacity minimum at 115 volts.
Overload light comes on during amplifier operation.	Output load is improperly tuned.	Follow tune-up procedure of section 2.5.
	Output coaxial cable is defective.	Check and repair output cable.
Circuit breaker resets to the OFF position during amplifier operation.	Output load is mistuning.	Follow tune-up procedure of section 2.5.
	Excessive power output level.	Reduce output level.

TABLE 4-1. TROUBLESHOOTING GUIDE (CONT.)

SYMPTOM	PROBABLE CAUSE	RECOMMENDATIONS
Push to reset button does not turn Overload light off.	Amplifier has overheated and thermostatic control has taken over.	Allow unit to cool down and overload light will turn off automatically. Check to see that the fan is turning and intake is free of obstructions or dirt build-up. Check input air temperature see that it is not excessive. Check the output load tuning. Reduce the output level.
Output power indication increases from cold start.	Normal Operation	Let unit run for five minutes and drift due to amplifier warm up will be eliminated.
Power output is below normal for a given level setting.	Load Mistuning	Check for mistuning.
	Faulty transistors	Check for blown fuses on circuit modules RS-8-4781. If fuses are blown that indicates faulty transistors, replace per section 4.4 or return to factory.

4.4 TRANSISTOR REPLACEMENT

4.4.1 Cover Removal

Remove the 1140LA cover by unscrewing the six (6) number 8-32 and the two (2) number 6-32 screws on each side of the cover and lifting up.

4.4.2 Faulty Transistor Identification

Observe the four power amplifier modules RS-8-4781 located on the left and right sides of the inverted "U" internal assembly.

Each module has four fuses immediately visible. If any of the fuses has been blown (this condition is clearly visible) then the associated power transistors should be replaced to achieve full specified power output. The two transistors are in a vertical line about 0.5 inches to the left of the blown fuse.

4.4.3 Inverted "U" Assembly Removal

In order to replace the faulty transistors the inverted "U" assembly must be detached and removed from the base plate as follows:

(a) Remove the four 6-32 flat head Phillips screws located in the four corners of the front panel. Pull the front panel forward until the inverted "U" assembly is clear.

(b) Remove the cover on the top of the inverted "U" assembly by removing the six (6) number 4-40 screws and lift off the cover.

(c) Remove the phono plug on the left side, about 5 inches from the front of the assembly of the 1140-4332 module located in the center of the inverted "U" assembly.

(d) Remove the BNC plug on the front edge of the RS-16-4801 module located in the center of the inverted "U" assembly.

(e) Unplug the two 15 pin strip connectors located in the left front of the inverted "U" assembly.

(f) Remove the 8 number 8-32 screws holding the inverted "U" assembly to the base plate and carefully lift the inverted "U" assembly straight up.

4.4.4 Power Amplifier Heatsink Removal

Remove the three 4-40 screws holding the 1140LA-3334 P.S. & Driver Heatsink assembly to the RS-16-3805 P.A. Heatsink assembly.

4.4.5 Power Amplifier Module Removal

(a) Remove the power amplifier module RS-8-4781 by removing the four number 4-40 screws located about .5 inches to the left of each fuse and the four number 4-40 screws located at each corner of the module.

(b) Pull apart the 9 pin strip connector located at the top of the module.

(c) Pull the power amplifier module straight out from the inverted "U" assembly.

4.4.6 Transistor Replacement

(a) Remove the four number 4-40 screws and associated hardware from the defective transistors.

(b) Remove the defective transistors and replace them with two new transistors (DTS-409 or equivalent).

CAUTION Be sure that the mica washer is placed between each transistor and the P.A. Heatsink assembly. Also be sure to place the nylon shoulder washer over each screw on the outside of the heatsink before the metal hardware is replaced.

(c) Tighten the 4-40 screws until the transistors are held securely.

(d) To replace the power amplifier module (RS-8-4781) carefully align the eight transistor sockets with the pins on each of the transistors and press module down until it sets on the eight number 4-40 spacers on the P.A. heatsink assembly.

(e) Replace the four number 4-40 screws .5 inches to the left of each fuse and the four number 4-40 screws in each corner of the module.

(f) Replace the three 4-40 screws attaching the P.A. heatsink to the P.S. & Driver Heatsink forming the inverted "U" assembly.

(g) Replace the inverted "U" assembly on the base plate, resecure and replace the connectors previously removed.

(h) Replace the cover over the inverted "U" assembly and resecure the six 4-40 screws previously removed.

(i) Replace the front panel and resecure with the four 6-32 flat head Phillips screws previously removed.

(j) Replace the cover.

4.5 PACKAGING FOR RESHIPMENT.

In the event of the equipment being returned for servicing it should be packed in the original shipping carton and packing material. If it is not available wrap the instrument in heavy paper or plastic and place in a rigid outer box of wood, fiberboard or very strong corrugated cardboard. Use ample soft packing to prevent movement. Provide additional support for projecting parts to relieve these of unnecessary shock. Close the carton securely and seal with durable tape. Mark the shipping container FRAGILE to ensure careful handling.

CHAPTER 5 SCHEMATIC AND PARTS LIST

5.1 SCHEMATIC DIAGRAM

A complete schematic diagram appears in figure 5-1.

5.2 PARTS LIST

Table 5-1 provides a list of all electrical parts and those mechanical parts which may be required for replacement. Electrical parts are listed by module number and by reference designations as indicated on the schematic diagrams. Parts list includes a description, part number and manufacturers federal supply code number. Table 5-2 provides a reference glossary of abbreviations used in the parts list.

5.3 LIST OF MANUFACTURERS

Table 5-3 provides a correlation of the manufacturers federal supply code numbers used in the parts list with the names and addresses of the manufacturers. If ENI's manufacturer code number (10226) appears, that part must be obtained directly from Electronic Navigation Industries, Inc.

5.4 ORDERING REPLACEMENT PARTS

To obtain replacement parts, address order or inquiry to Electronic Navigation Industries, Inc., or its authorized service facility. Identify parts by number as listed in the parts list.

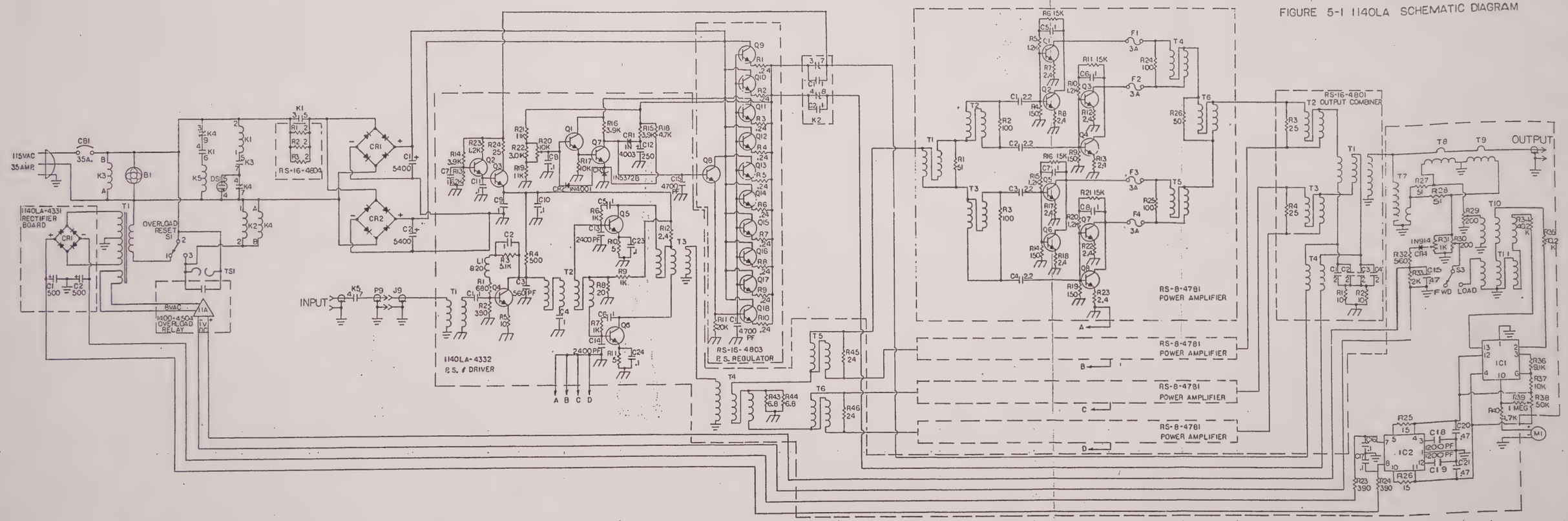

Figure 5-1 Schematic Diagram

TABLE 5-1. REPLACEMENT PARTS LIST
MODEL 1140LA

REF. DESIGN	DESCRIPTION	MFG. CODE	PART NO.
	POWER DISTRIBUTION ASSEMBLY	10226	1140LA-2331
M1	Meter	32171	841-196
S1/DS1	Overload Reset Switch/Lamp	87034	418-8-1-A1H
S3	Forward/Load Switch	31356	ST1-1
CB1	Circuit Breaker	04809	QOU-135
A69A	Overload Relay	10226	EGB1400-4504
A140	Rectifier Board	10226	1140LA-4331
A140CR1	Bridge Rectifier	83003	VS148
A140C1,C2	Capacitor, 500MFD, 50V	56289	500D
J2,J3	Connector BNC	13511	UG657/U
B1	Fan	82877	TN3A2
K1	Contactor	78290	425BXX
K2	Contactor	78290	425XXB
K3	Relay	78290	A283XAXC2
K4,K5	Relay	78290	A283XBXC2
CR1,CR2	Bridge Rectifier	04713	MDA3504
C1,C2	Capacitor, 5400 MFD, 200V	13688	86F207M
T1	Transformer	12715	AM7023
A113	Resistor Board	10226	RS-16-4804
A113 R1,R2,R3	Resistor 2 Ohm 20 Watt	44655	1802B
A113 C1,C2	Capacitor, 1 MFD, 250V	74861	2.5LUMZ100
	P.A. HEATSINK ASSEMBLY (2 Required)	10226	RS-16-3805
TS1	Thermoswitch	14604	3450-088-216
Q1-Q16	Transistor	72560	DTS-409
R24,R15,R27, R28	Resistor 100 Ohm 50 Watt	91637	NH-50-100
R26,R29	Resistor 50 Ohm 50 Watt	91637	NH-50-50
A108	Power Amplifier (2 Required)	10226	RS-8-4781
A108 R1	Resistor, 51 Ohm, 2W, 5%	01121	RC42GF510J
A108 R2,R3	Resistor, 100 Ohm, 2W, 5%	01121	RC42GF101J
A108 R4,R9, R14,R19	Resistor, 150 Ohm, 1/2W, 5%	01121	RC20GF151J
A108 R5,R10, R15,R20	Resistor, 1.2K Ohm, 12W	12697	VPR10F-1200
A108 R6,R11, R16,R21	Resistor, 1.5K Ohm, 2W, 5%	01121	RC42GF153J
A108 R7,R8, R12,R13, R17,R18, R22,R23	Resistor, 2.4 Ohm, 5W	44655	995-5B

TABLE 5-1. REPLACEMENT PARTS LIST
MODEL 1140LA (Continued)

REF. DESIGN	DESCRIPTION	MFG. CODE	PART NO.
A108C1,C2, C3,C4	Capacitor 2.2 MFD 100V	74861	1LUMZ220
A108C5,C6, C7,C8	Capacitor 1.0 MFD 250V	74861	2.5LUMZ100
A108T1-T3	Transformer	10226	
A108T4-T-6	Transformer		
A108F1-F4	Fuse 3.0A 3AG	75915	312003
	P.S. & DRIVER HEATSINK ASSEMBLY	10226	1040LA-3334
Q3,Q9-Q18	Transistor	10226	ENI-1
Q4,Q8	Transistor	79089	2N3583
Q5,Q6	Transistor	72560	DTS-409
R1,R2	Resistor, 10 Ohm, 50W	91637	NH-50-10
R3,R4,R25	Resistor, 25 Ohm, 50W	91637	NH-50-25
A115A	Power Supply & Driver Module	10226	1140LA-4332
A115R1	Res., 680 Ohm, 1/2W, 5%	01121	RC20GF681J
A115R2,R23, R24	Res., 390 Ohm, 1/4W, 5%	01121	RC07GF391J
A115R3	Res., 1.5K Ohm, 1/4W, 5%	01121	RC07GF512J
A115R4	Res., 500 Ohm, 8W	12697	VFR-5-F-500
A115R5	Res., 10 Ohm, 1/2W, 5%	01121	RC20GF100J
A115R6,R7,R9	Res., 1K Ohm, 5W	12697	VC5E-1000
A115R8	Res., 20 Ohm, 2W, 5%	01121	RG42GF200J
A115R10,R11	Res., 5 Ohm, 5W	12697	VC5E-5
A115R12	Res., 2.4 Ohm, 5W	44655	995-5B
A115R13	Res., 6.2K Ohm, 2W, 5%	01121	RC42GF622J
A115R18	Res., 4.7K Ohm, 2W, 5%	01121	RC42GF472J
A115R14,R15, R16	Res., 3.9K Ohm, 1W, 5%	01121	RC32GF392J
A115R17	Res., 10K Ohm, 1/2W, 5%	01121	RC20GF103J
A115R19,R21	Res., 11K Ohm, 1/2W, 1%	16299	RN65D1102F
A115R20	Res., 10K Ohm, Pot.	32997	3389T-1-103
A115R22	Res., 3.01K Ohm, 1/4W, 1%	16299	RN55D3011F
A115R25,R26	Res., 15 Ohm, 1/4W, 5%	01121	RC07GF150J
A115R27,R28	Res., 51 Ohm, 1/2W, 5%	01121	RC20GF510J
A115R29,R30	Res., 200 Ohm, Pot.	32997	3389T-1-201
A115R31	Res., 1K Ohm, Pot.	32997	3389T-1-102
A115R32	Res., 560 Ohm, 1/4W, 5%	01121	RC07GF561J
A115R33	Res., 2K Ohm, 1/4W, 5%	01121	RC07GF202J
A115R34,R35	Res., 40.2K Ohm, 1/4W, 1%	16299	RN60D4022F
A115R36	Res., 9.1K Ohm, 1/4W, 5%	01121	RC07GF912F
A115R37	Res., 10K Ohm, 1/4W, 5%	01121	RC07GF103J

TABLE 5-1. REPLACEMENT PARTS LIST
MODEL 1140LA (Continued)

REF. DESIGN	DESCRIPTION	MFG. CODE	PART NO.
A115R38	Res., 50K Ohm, Pot.	32997	72PXR50K
A115R39	Res., 1 Meg. Ohm, 1/4W, 5%	01121	RC07GF105J
A115R40	Res., 4.7K Ohm, 1/4W, 5%	01121	RC07GF472J
A115R43,R44	Res., 6.8 Ohm, 1W, 5%	01121	RC32GF6R8J
A115R45,R46	Res., 24 Ohm, 2W, 5%	01121	RC42GF240J
A115C1,C4,C5, C6,C7,C9	Cap, 1MFD, 250V	74861	2.5LUMZ100
A115C2,C8,C10, C11,C22, C23,C24	Cap., 1 MFD, 250V	74861	2.5LUMZ10
A115C3	Cap., 560PF, Mica	09023	CM06FD561J03
A115C12	Cap., 260 MFD, 18V	09023	WBR260-180
A115C13,C14	Cap., 2400PF, Mica	09023	CM06FD242J03
A115C15,C20, C21	Cap., .47MFD, 50V	72782	8131-050-651
A115C16,C17	Cap., .1MFD, 50V	72928	8131-050-651
A115C18,C19	Cap., 1200PF, Mica	09023	CM06FD122J03
A115CR1	Diode	79089	IN4003
A115CR2	Diode	79089	IN4001
A115CR3	Zener Diode, 62V	79089	IN5372B
A115CR4	Diode	79089	IN914
A115IC1	Multiplier	79089	CA309ID
A115IC2	Voltage Regulator	04713	MC1468L
A115Q1,Q2,Q7	Transistor	79089	2N3439
A115T1	Transformer	10226	
A115T2	Transformer	10226	
A115L1	Choke, 820 uhy	71279	3712-4-2
A115T3	Transformer	10226	
A115T4	Transformer	10226	
A115T5,T6	Transformer	10226	
A115T7	Transformer	10226	
A115T8,T9	Transformer	10226	
A115T10,T11	Transformer	10226	
A114	Power Supply Regulator	10226	RS-16-4803
A114R1-R10	Res., .24 Ohm, 2W, 5%	44655	BHW-.24
A114R11	Res., 20K Ohm, 1W, 5%	01121	RC32GF203J
A114C1	Cap., 4700PF, Mica	09023	CM06FD472J03
A116	Output Combiner	10226	RS-16-4801
A116C1-C4	Cap., 2 MFD, 250V	74861	2.5 LUMZ200
A116T1	Transformer	10226	
A116T2,T3	Transformer	10226	
A116T4	Transformer	10226	
A114C2	Cap., 1 MFD, 250V	74861	2.5LUMZ100

TABLE 5-2. GLOSSARY OF ABBREVIATIONS

AMP	AMPERES	PF	PICOFARAD
AMPL	AMPLIFIER	POT	POTENTIOMETER
BKT	BRACKET	REF	REFERENCE
CAP	CAPACITOR	RES	RESISTOR
IN	INCHES	MFD	MICROFARADS
K	KILOHMS	V	VOLTS
MTG	MOUNTING	W	WATTS

TABLE 5-3. LIST OF MANUFACTURERS

FEDERAL SUPPLY CODE	MANUFACTURER	ADDRESS
01121	Allen Bradley Co.	Milwaukee, WI
04713	Motorola, Inc.	Phoenix, AZ
04809	Square D Co.	Secaucus, NJ
09023	Cornell-Dubilier Electronic	Sanford, NC
10226	Electronic Navigation Ind., Inc.	Rochester, NY
12697	Clarcstat Mfg. Co. Inc.	Dover, NH
12715	American Magnetics Corp.	Carterville, IL
13511	Amphenol Corp. Connector Div.	Los Gatos, CA
13688	General Electric Co.	Syracuse, NY
14604	Elmwood Sensors, Inc.	Cranston, RI
16299	Corning Glass Works Electronic	Raleigh, NC
31356	J-B-T Instruments, Inc.	New Haven, CT
32171	Modutec, Inc.	Norwalk, CT
32997	Bourns Inc. Trimpot	Riverside, CA
44655	Ohmite Mfg. Co.	Skokic, IL
56289	Sprague Electric Co.	North Adams, MA
72560	Delco Products Div. of GM	Dayton, OH
72982	Erie Technological Products, Inc.	Erie, PA
74861	Industrial Condenser Corp.	Chicago, IL
75915	Littlefuse, Inc.	Des Plaines, IL
78290	Struthers-Dunn, Inc.	Pitman, NJ
79089	RCA Corp. Receiving Tube Div.	Harrison, NJ
82877	Rotron, Inc.	Woodstock, NY
83003	Varo, Inc.	Garland, TX
87034	Marco-Oak Industries, Inc.	Anaheim, CA
91637	Dale Electronics, Inc.	Columbus, NB
71279	Cambridge Thermionic Corp.	Cambridge, MA

TABLE 5-1. REPLACEMENT PARTS LIST
MODEL 1140LA (Continued)

REF. DESIGN	DESCRIPTION	MFG. CODE	PART NO.
A115R38	Res., 50K Ohm, Pot.	32997	72PXR50K
A115R39	Res., 1 Meg. Ohm, 1/4W, 5%	01121	RC07GF105J
A115R40	Res., 4.7K Ohm, 1/4W, 5%	01121	RC07GF472J
A115R43,R44	Res., 6.8 Ohm, 1W, 5%	01121	RC32GF6R8J
A115R45,R46	Res., 24 Ohm, 2W, 5%	01121	RC42GF240J
A115C1,C4,C5, C6,C7,C9	Cap, 1MFD, 250V	74861	2.5LUMZ100
A115C2,C8,C10, C11,C22, C23,C24	Cap., 1 MFD, 250V	74861	2.5LUMZ10
A115C3	Cap., 560PF, Mica	09023	CM06FD561J03
A115C12	Cap., 260 MFD, 18V	09023	WBR260-180
A115C13,C14	Cap., 2400PF, Mica	09023	CM06FD242J03
A115C15,C20, C21	Cap., .47MFD, 50V	72782	8131-050-651
A115C16,C17	Cap., .1MFD, 50V	72928	8131-050-651
A115C18,C19	Cap., 1200PF, Mica	09023	CM06FD122J03
A115CR1	Diode	79089	IN4003
A115CR2	Diode	79089	IN4001
A115CR3	Zener Diode, 62V	79089	IN5372B
A115CR4	Diode	79089	IN914
A115IC1	Multiplier	79089	CA3091D
A115IC2	Voltage Regulator	04713	MC1468L
A115Q1,Q2,Q7	Transistor	79089	2N3439
A115T1	Transformer	10226	
A115T2	Transformer	10226	
A115L1	Choke, 820 uhy	71279	3712-4-2
A115T3	Transformer	10226	
A115T4	Transformer	10226	
A115T5,T6	Transformer	10226	
A115T7	Transformer	10226	
A115T8,T9	Transformer	10226	
A115T10,T11	Transformer	10226	
A114	Power Supply Regulator	10226	RS-16-4803
A114R1-R10	Res., .24 Ohm, 2W, 5%	44655	BHW-.24
A114R11	Res., 20K Ohm, 1W, 5%	01121	RC32GF203J
A114C1	Cap., 4700PF, Mica	09023	CM06FD472J03
A116	Output Combiner	10226	RS-16-4801
A116C1-C4	Cap., 2 MFD, 250V	74861	2.5 LUMZ200
A116T1	Transformer	10226	
A116T2,T3	Transformer	10226	
A116T4	Transformer	10226	
A114C2	Cap., 1 MFD, 250V	74861	2.5LUMZ100

TABLE 5-2. GLOSSARY OF ABBREVIATIONS

AMP	AMPERES	PF	PICOFARAD
AMPL	AMPLIFIER	POT	POTENTIOMETER
BKT	BRACKET	REF	REFERENCE
CAP	CAPACITOR	RES	RESISTOR
IN	INCHES	MFD	MICROFARADS
K	KILOHMS	V	VOLTS
MTG	MOUNTING	W	WATTS

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10226	Electronic Navigation Ind., Inc.	Rochester, NY
12697	Clarcstat Mfg. Co. Inc.	Dover, NH
12715	American Magnetics Corp.	Carterville, IL
13511	Amphenol Corp. Connector Div.	Los Gatos, CA
13688	General Electric Co.	Syracuse, NY
14604	Elmwood Sensors, Inc.	Cranston, RI
16299	Corning Glass Works Electronic	Raleigh, NC
31356	J-B-T Instruments, Inc.	New Haven, CT
32171	Modutec, Inc.	Norwalk, CT
32997	Bourns Inc. Trimpot	Riverside, CA
44655	Ohmite Mfg. Co.	Skokic, IL
56289	Sprague Electric Co.	North Adams, MA
72560	Delco Products Div. of GM	Dayton, OH
72982	Erie Technological Products, Inc.	Erie, PA
74861	Industrial Condenser Corp.	Chicago, IL
75915	Littlefuse, Inc.	Des Plaines, IL
78290	Struthers-Dunn, Inc.	Pitman, NJ
79089	RCA Corp. Receiving Tube Div.	Harrison, NJ
82877	Rotron, Inc.	Woodstock, NY
83003	Varo, Inc.	Garland, TX
87034	Marco-Oak Industries, Inc.	Anaheim, CA
91637	Dale Electronics, Inc.	Columbus, NB
71279	Cambridge Thermionic Corp.	Cambridge, MA

NOTES

NOTES

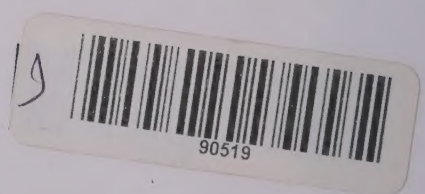
FACTORY SERVICE

When Factory Service is required, the following steps should be taken:

(1) Notify ENI, giving full details of the difficulty. Include the instrument's serial number.

(2) Upon receipt of shipping instructions, forward the instrument, transportation prepaid to the factory or to the authorized repair station indicated on the instructions.

If requested, an estimate of the charges will be made before the work begins, provided the instrument is not covered by the warranty.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